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Encl. # 12 to

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PROPOSAL FOR

L-BAND ANTENNA FOR SYSTEM 1

6 May 1957

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including this title sheet.)

Included in
amendment 11

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1. <u>Introduction</u>

a. The purpose of the L-band antenna for use with System 1 is to extend the coverage of the system to the frequency range from 150 mc to 1000 mc.

b. The antenna proposed is a scaled-down version of a design previously developed by this contractor for System 4 to cover the frequency range from 150 mc to 1200 mc. (See photographs.) The proposed antenna will be reduced in size by 15% because of the space limitations in the antenna mounting area available for System 1.

c. Antennas will be provided which can be installed in the mounting area available for System 1 antennas and which are capable of satisfactory operation over the frequency range from 150 mc to 1000 mc.

d. In addition, sets of coaxial-construction low- and high-pass filters will be provided so that the system will be capable of selecting the frequency ranges from 300 mc to 600 mc, 600 mc to 1000 mc, 300 mc to 1000 mc, below 300 mc, below 600 mc, and below 1000 mc by connecting the appropriate filter combinations to the antenna terminals.

e. Crystal video detectors will be provided for use with the system. These will either be of the tuned variety covering the 150mc-to-300mc, 300mc-to-600mc and 600mc-to-1000mc ranges, or a broadband detector (Sage Laboratories 101BDL) utilizing the Sylvania Tripolar IN358A crystal which will operate over the entire 150mc-to-1000mc range with a sensitivity equivalent to that of the tuned detectors over their restricted ranges.

2. <u>Physical Details of the Antenna</u>

a. The antenna will be a cavity-backed double Archimedean spiral design. (See photographs of System 4 prototype.) It will have a circular aperture of 14.5" diameter and the depth of its cylindrical cavity will be 6.4". The spiral arms will be formed by an etching process of 1 mil thick copper on a sheet of 1/16" thick Epoxy dielectric and the cavity will be made of spun aluminum 0.015" thick. The shape of the rear wall was determined as a result of a program to broadband the design from the 2- or 3-to-1 bandwidth characteristic of a spiral aperture employing a right circular cylindrical cavity. This antenna design is capable of satisfactory operation over a bandwidth ratio of 8 to 1.

b. To improve the low-frequency operation of the antenna, each spiral arm will be terminated at its outer end by a series of 3 resistors of 330 ohms, 200 ohms, and 75 ohms, spaced along the spiral arm and connected to the wall of the cavity.

c. A rigid brass coaxial feed line of 0.147" outside diameter will connect to the spiral arms at the center of the aperture and extend to a type N connector which will be attached by its mounting flange to the center of the rear wall of the cavity. The inner conductor of the coaxial line will not be tapered and will be supported at the rear wall of the cavity by the insulator of the type N connector, and at the aperture of the antenna by a teflon spacer as well as by its connection to one of the spiral arms. The outer conductor of the coaxial feed line will be secured by the type N connector at one end and by its connection to the other spiral arm at its other end.

d. The Epoxy face-plate containing the spiral arms will be bolted to basket nuts riveted to the wall of the cavity at six points. Four small brackets will be riveted to the rear wall of the cavity near its rim to mount the antenna to the main brackets which secure it to the airframe.

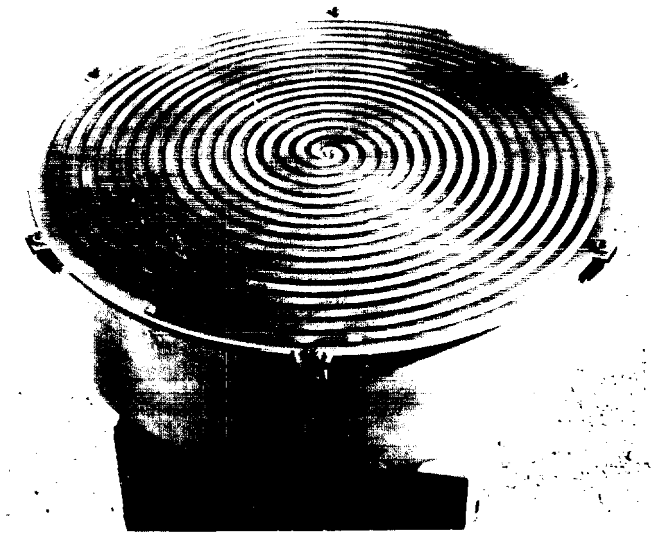
e. The antenna described above may be mounted in the System 1 antenna area at a depression angle of approximately

12°. To allow mounting of the antenna at an angle of 25° would require a reduction in depth of its cavity of the order of 50%. This would significantly reduce its efficiency at the low frequency end of its operating range and therefore is not advisable.

3. Electrical Performance of the Antenna

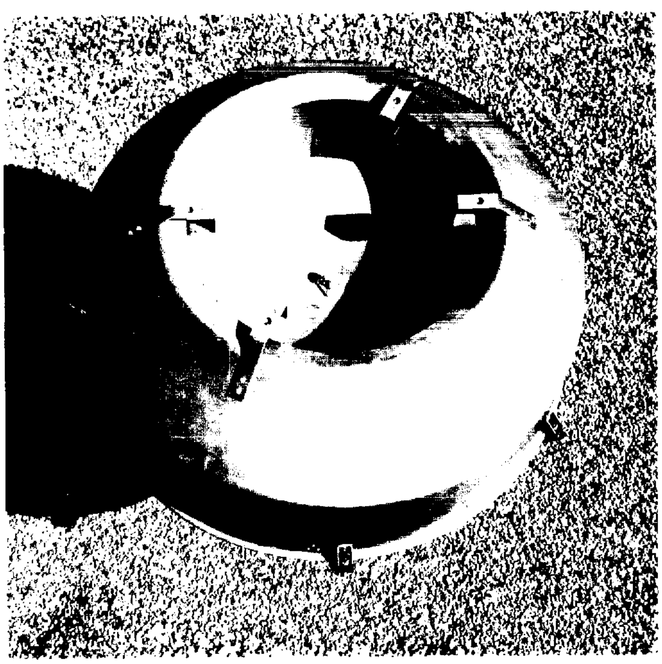
a. The original antenna developed for System 4 exhibits a VSWR of about 2 1/2 to 1 or better over the band, except for a peak of 3 1/2 to 1 in the neighborhood of 425 mc, and has an elliptically polarized beam whose average width between half power points is 75°. Its efficiency is of the order of 0.2% at the lower end of the band, but rises to 11% at 300 mc, then rises to about 33% at 600 mc, and remains at approximately this level throughout the remainder of the band.

b. It is to be expected that the principal effects of reducing the size of the original antenna will be to reduce the efficiency which may be obtained at the lower end of the frequency band. It is estimated that the efficiency may drop to 0.1% at 150 mc, which would result in a power gain with respect to a $\lambda/2$ dipole of -20 db at that frequency. However, it should have a power gain equal to a $\lambda/2$ dipole at 300 mc, and over 5 db better than the dipole above 600 mc. In view of these considerations, the major effort which will be undertaken will be directed toward improving the low-frequency efficiency, since the other characteristics of the antenna are adequate for the intended application.

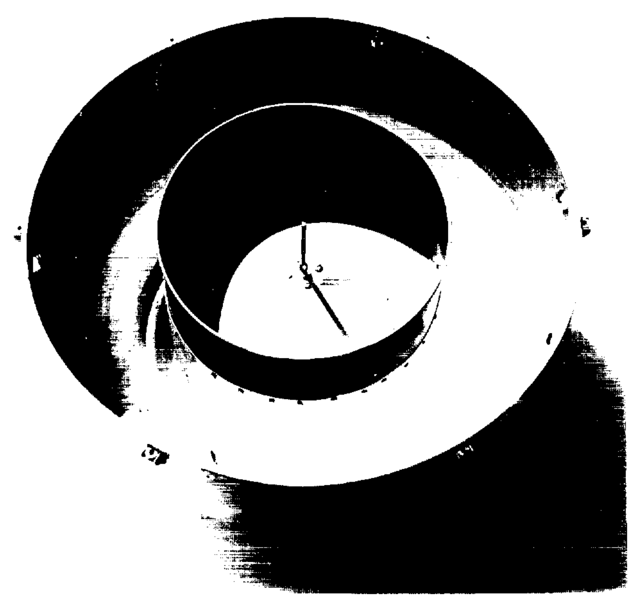


Prototype Antenna

Side View



Bottom View



Etched Spiral Removed to Show Cavity

System 4 150mc-to-1200mc Antenna, Four Views